

# **Confined Space Entry: There's Always Room To Do It Right!**



## **TELNPS Participant Guide DAY 2**

Prepared by  
NPS Risk Management Division

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## How to Interact with the Instructor

We encourage you to ask questions and share your comments with the instructors throughout this TELNPS course.

If you were physically in the classroom with the instructor, you would raise your hand to let him know you had a question or comment. Then you would wait for the instructor to recognize you and ask for your question. We are all familiar with that “protocol” for asking questions or making comments.

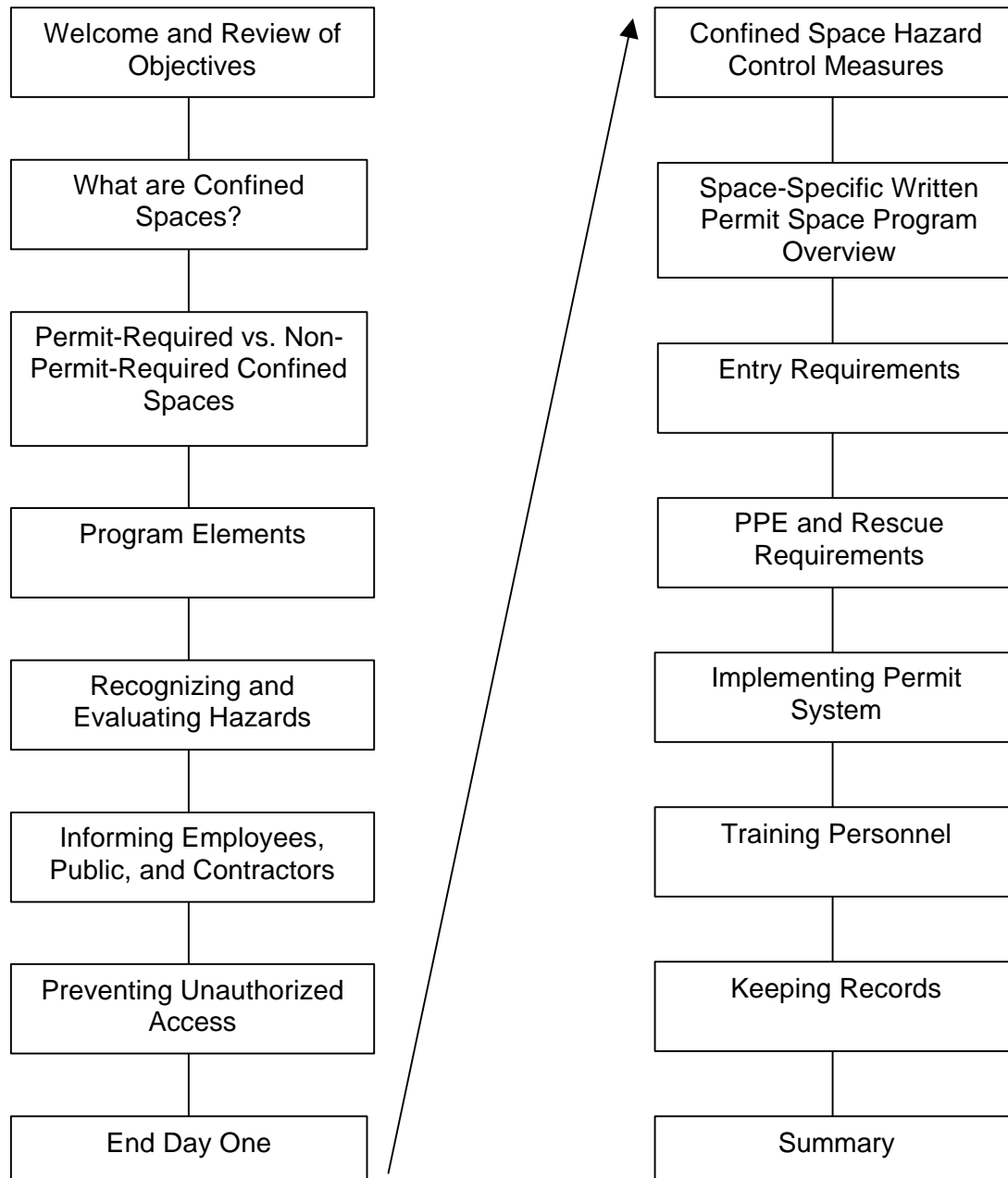
With TELNPS courses there is also a “protocol” to follow to ensure you can easily ask questions and others can participate as well. It may seem a little strange at first asking a question of a TV monitor. Remember, it is the instructor you are interacting with and not the monitor. As you ask more questions and participate in more TELNPS courses, you will soon be focusing only on the content of your question and not the equipment you are using to ask it.

As part of the TEL station equipment at your location, there are several push to talk microphones. Depending on the number of students at your location, you may have one directly in front of you or you may be sharing one with other students at your table.

*When you have a question, press the push to talk button and say,  
“Excuse me [instructor’s first name], this is [your first name]  
at [your location]. I have a question (or I have a comment).”  
Then release the push to talk button. This is important.  
Until you release the button, you will not be able to hear the instructor.*

The instructor will acknowledge you and then ask for your question or comment. Stating your name and location not only helps the instructor, but also helps other students who are participating at different locations to get to know their classmates.

## Confined Spaces: There's Always Room To Do It Right! Course Map



**Course Objectives****Notes**

At the conclusion of this course, you should be able to:

1. Identify a confined space.
2. Identify a permit-required confined space.
3. Recognize confined space hazards.
4. Conduct a confined space evaluation.
5. Know the requirements and method for informing employees and contractors of the existence of confined spaces.
6. Describe atmospheric test equipment and how it is used.
7. Describe methods for controlling confined space hazards.
8. Describe ways to effectively employ ventilation equipment.
9. Discuss the requirements for implementing a permit system, including the contents of a permit system, when a hot work permit is required, and how it is prepared.
10. Explain the requirements for training authorized entrants, attendants, entry supervisors, and rescuers.
11. Describe non-entry rescue equipment and its use.
12. List the required elements of a permit-required confined space entry program.
13. Prepare written permit space entry procedures for permit spaces in his or her park.
14. List record keeping requirements.

## **Confined Space Hazard Control Measures: Atmospheric Hazards and Ventilation**

## **Notes**

### **Ventilation is required when the permit space atmosphere**

- Has insufficient oxygen (< 19.5%) or excess oxygen (> 23.5%);
- Has flammable dusts or vapors;
- Has toxic vapors, fumes, fibers, mists, or gases;
- Exposes workers to heat stress.
- Is the site of actions that may produce hazardous vapors, fumes, fibers, mists, or gases, or which may lead to oxygen deficiency or excess.

**Hotwork** operations include welding, torch cutting, arc gouging, and brazing and soldering. Hotwork can produce hazardous gases, fumes, and vapors that must be controlled by ventilation. Proper ventilation during hotwork removes contaminated air and replaces it with good, breathable air.

**Two types of ventilation** we will refer to with respect to hotwork are

1. *Dilution Ventilation*, in which large amounts of air are moved through a confined space, exhausting contaminated air through one opening and replacing it with fresh air from another opening, and
2. *Local Exhaust Ventilation*, in which air contaminants are captured near their point of origin and exhausted outside the confined space using a length of flexible ducting with a flange (hood) on the worker's end and an air-moving device such as a fan on the other end.

We need to be aware of the additional ventilation requirements that apply to hotwork within confined spaces [29 CFR 1910.252© and 29 CFR 1926.353]. Ventilation is required when

- Space is less than 16 feet high;
- Volume per welder is less than 10,000 cubic feet;
- Space contains airflow obstructions such as partitions, structural barriers, baffles, trays, etc.

Ventilation must

- Provide a minimum of 2,000 cfm (cubic feet per minute) of airflow per welder through *dilution ventilation* —or—
- Provide each welder with *local exhaust ventilation* that maintains an airflow velocity of 100 fpm (feet per minute) toward the air intake.

## **Confined Space Hazard Control Measures: Atmospheric Hazards and Ventilation (cont)**

## **Notes**

Certain conditions require *local exhaust ventilation* or *supplied air respiratory protection* (provided by a respirator that supplies wearer with clean air from a compressor or compressed air cylinder). These include hotwork involving

- Flourine compounds
- Zinc
- Lead
- Cadmium
- Mercury
- Beryllium (requires both local exhaust and supplied air respirator).
- Chromium
- Stainless Steels using inert gas metal arc processes
- Other elements (Check MSDSs for base and filler metals in any hotwork process as well as the ACGIH *Guide to Occupational Exposure Values* or like resource for especially low exposure limits.)

### **Types of Ventilation Devices**

The two types of air-moving devices in widest use for confined spaces are

- Fans—Air-driven, steam-driven, or electrically-powered.
- Venturi-type eductors—“Air Horns” or “Air Movers” that are air-powered and use venturi effects to move air.

**Air-moving devices are rated** according to

- 1) the quantity of air they move without any airflow restriction, also called “free air delivery” (measured in cfm).
- 2) the quantity of air they will move while overcoming. airflow restrictions, also called “effective blower capacity” (measured in inches of static pressure).
- 3) the quantity of air (SCFM) and air pressure (psi) needed to run the fan or eductor at capacity.
- 4) the electrical power (watts or volts/amps) needed to run electrically powered devices at capacity.

It is essential to be informed of these rating systems and to **choose an air-moving device** that will pull enough air through the conditions present to achieve proper ventilation.

## **Confined Space Hazard Control Measures: Atmospheric Hazards and Ventilation (cont)**

## **Notes**

### **Measuring Airflow**

1. Measure the **average make-up air velocity (V)** in feet per minute (fpm).
  - a. For a circular vent, use the anemometer to take up to 20 velocity readings along two 10-point transects perpendicular to each other. For a rectangular vent, divide the opening into a grid of 16-64 equal areas, the center of each area not more than 6 inches apart, and measure from the center point of each area. Then add the readings and divide by the number of readings to find the average. A quick estimate average velocity can be found by taking 90% of the reading taken at the approximate center of the opening. This may not be accurate, however, because of airflow restrictions within the confined space or because of an irregularly shaped opening. [Pre-taped video demonstration of velocity measurement using anemometer.]
  - b. For spaces with multiple make-up air openings, measure the largest first, as the airflow through it may be great enough to eliminate the need to measure the smaller openings.
2. For each opening, calculate the **cross-sectional area** (in sqft) of the opening using the following formulas:  
For a circular vent,  **$A=3.1416 \times \text{radius}^2$**   
For a rectangular vent,  **$A=\text{length side a} \times \text{length side b}$** .
3. For each opening, calculate the **airflow or quantity (Q) of make-up air** entering the confined space (in cfm) by multiplying the average airflow velocity by the cross-sectional area (in sqft) of the opening:  
 **$Q=VA$**
4. Determine if the airflow is within requirements for safe entry. **Modify ventilation controls** as necessary.

**Confined Space Hazard Control Measures:  
Atmospheric Hazards and Respirators****Notes**

Respirators are a last line of defense when it comes to hazardous vapors, mists, fumes, dusts, and gases. They are to be used only in one of the following circumstances:

1. When engineering controls fail to reduce atmospheric hazards to within acceptable levels.
2. During installation of engineering controls.
3. When effective engineering controls cannot be used.
4. During short-term maintenance procedures.
5. During emergencies; for example, escape and rescue operations.

Remember the importance of following your site's Respiratory Protection Program as you perform procedures such as exposure assessment, respirator selection, medical evaluation, fit testing, respirator storage and maintenance, and employee training.



## **Confined Space Hazard Control Measures: Explosion and Ignition Hazards**

In controlling **explosion and ignition hazards**, our goal is to avoid turning our confined space into a bomb. We can do this by eliminating both the fuel and the spark that would lead to ignition and explosion.

Here are some essential guidelines:

1. Control all ignition sources within the space atmosphere by
  - Eliminating all hot work in the area.
  - Prohibiting the carrying of lighters, matches, or other sources of ignition into the space.
  - Using only equipment approved for use within a hazardous space.
  - Removing spark-producing metal from soles of shoes; for example, embedded nails.
  - Prohibiting the wearing of clothes that produce static electricity, such as synthetics like Nylon.
  - Use bonded and grounded equipment only.
2. Inert and vent simultaneously.
3. Make certain that exhaust air does not present a hazard to workers.
4. Use both local exhaust ventilation and forced air-supplying ventilation.

## **Confined Space Hazard Control Measures: Physical Hazards**

### **PPE (personal protective equipment) General Guidelines**

- The use of PPE is required by OSHA when there is any risk of injury to the body.
- It is essential to remember, however, that PPE is only effective when worn—and worn correctly.
- To ensure this, employees must be trained, and supervisors must have authority to require its proper use.
- PPE must also be inspected and maintained on a regular schedule.

### **Fall protection devices**

- *Body Belts* are not fall protection devices, though they can decrease the probability of falls.
- *Chest Harnesses* are approved for limited vertical free fall hazards and also for retrieval in rescue situations.
- *Full-Body Harnesses* are approved for stopping falls and for retrieval.
- *Wristlets* are wrist straps to which retrieval lines are secured if they can be shown to be safer and more effective than a harness in a specific situation.
- *Independent Support Devices* like a bosun's chair are helpful in lowering entrants to inspect and maintain confined spaces, but an independent lifeline attached to the entrant is also required.

### **Lockout**

The installation of a lock on energy devices such as circuit breakers and shut-off valves, which prevents operation of the device until removal of the lock by authorized personnel. *Blanks* and *blinds* also fit into this category.

### **Tagout**

The attachment of a tag, label, or sign to an energy-isolating device in order to warn against unauthorized operation of the device.

### **Lockout/tagout Procedure**

1. Isolating or deactivating the hazardous source or equipment.
2. Locking or tagging the valve or switch.
3. Leaving the lock or tag in place until the permit space work is completed.

### **Special Entry Requirements**

- Air monitoring instruments
- Special lighting
- Communication devices
- Special protective clothing
- Climbing devices, such as ladders
- First aid, emergency, and rescue equipment

## **Prepare a Space Specific Written Permit Program: Overview**

Space-specific procedures provide the basis for training entry and rescue personnel, and they provide the conditions and requirements under which the entry supervisor determines whether an entry will be authorized. They must include the following information:

1. Space Identification
2. Classification as permit-required (indicate whether alternate entry method may be used) or non-permit space.
3. Reasons for entry
4. Hazards
5. Required surveillance and inspection
6. Entry Requirements
7. Personal Protective Equipment Requirements
8. Rescue requirements

See Appendix C for several examples of space specific procedures.

## **Prepare a Space Specific Written Permit Program: Entry Requirements**

Specific entry requirements must be met prior to entry into a permit space. They are as follows:

1. Entry supervisor prepares an entry permit, which he or she will later sign, documenting that the space is safe to enter.
2. Meet all space-specific requirements for acceptable entry conditions.
3. Make Material Safety Data Sheets available on-site for any hazardous or toxic product expected to be encountered.
4. Isolate the space. Storage tanks, process vessels, sumps, pipelines, pits, and similar spaces must be isolated from any other pipeline system prior to being entered. All connecting lines must be physically disconnected or blinded at a point as near as possible to tanks or vessels. The practice of double block and bleed does not meet the definition of blinding when personnel entry is involved. Pipelines between the confined space and the first valve, blank or associated equipment may contain material or hazardous contaminants. Therefore the isolation procedure must ensure that such piping has been flushed, cleaned or purged. [Use slides or demo to help participants understand concept.]
5. Depressurize equipment under positive or negative pressure. [Show slides, or demo.]
6. Lockout and tag-out equipment, systems and processes. Successful isolation shall be confirmed by the Entry Supervisor prior to allowing entry. [Show slides or demo.]
7. Electrical equipment including tools, lighting, communications and test equipment used in hazardous locations shall meet the appropriate requirements of 29CFR 1910.399 and NFPA 70.
8. Where there is a potential for electrical shock, appropriate electrical equipment or systems shall be used. This includes protection such as ground fault circuit interrupters (GFCI), assured grounding systems, double insulated tools, separately derived systems and low voltage systems.
9. Guard all openings to the space with appropriate barriers to prevent accidental fall.
10. Post warning signs.
11. Test the atmosphere with calibrated, direct-reading instruments for:
  - Oxygen (level must be between 19.5 and 23.5 %)
  - Flammability (less than 10% of LEL)
  - Potential toxic air contaminantsNote: Normal atmospheric conditions are the goal for entries. However, under certain

## **Prepare a Space Specific Written Permit Program: Entry Requirements**

circumstances, entry may be required when a hazardous atmosphere exists such as when ventilation systems are not capable of controlling the hazard, when entry is required in order to set ventilation systems, or during entry rescues. In these cases appropriate exposure control measures, such as SCBA or supplied air respirators, must be planned for and implemented.

12. Continuous forced air ventilation shall be used as follows:
  - 1) Ensure ventilation equipment is set up so that source air is free from airborne contaminants.
  - 2) Ensure that the ventilation is directed toward the area where the entrant is working.
13. Test the atmosphere periodically for O<sub>2</sub>, LEL, and toxic gases or vapors during the entry. Follow any specific periodic monitoring instructions prescribed for spaces. In some cases continuous monitoring will be required.
14. If an uncontrolled hazardous atmosphere, in other words, atmospheric hazards not specified on the entry permit, is detected during entry:
  - 1) Entrants not wearing appropriate respiratory protection for the hazard must leave the space immediately;
  - 2) The space shall be evaluated to determine how the hazardous atmosphere developed; and
  - 3) The hazards will be controlled prior to reentry into the space.
15. Ensure that whenever drains, vents, or piping are left opened, reversal of flows or air contamination from adjacent processing or chemical handling cannot enter the confined space. [Demo with flow diagram?]
16. Ensure trained rescue personnel and a means of summoning those services are available and that at least one attendant is provided outside the space.
17. Ensure safe means of entry and egress from the space is available.
18. The **completed permit** will be made available at the time of the entry to *all authorized entrants* so that they can confirm that all pre-entry preparations have been completed. The permit shall be placed in a clear plastic protective cover and affixed securely to, or near, the entrance.
19. The entry supervisor will terminate entry and cancel the entry permit when the entry operations covered by the permit have been completed, or when a condition that is not allowed under the entry permit arises in or near the permit space. The permit space will be reevaluated in the presence of any authorized entrant or that employee's authorized representative who requests such reevaluation because the entrant or representative has reason to believe that the evaluation may not have been adequate.
20. No food, smokeless tobacco, or beverages will be taken into a confined space.

**Prepare a Space Specific Written Permit Program:  
Entry Requirements**

21. Once the job is complete and all entrants have exited the space, and the space is ready to be returned to normal service, the entry supervisor will debrief personnel involved in the entry and cancel the permit. Any problems encountered during the entry operation shall be noted so that appropriate revisions to the permit space program can be made.
22. Canceled entry permits will be kept on file with the Safety officer for at least 1 year.

## **Prepare a Space Specific Written Permit Program: Alternate Entry Requirements**

If it can be demonstrated that the only hazard posed by the permit space is an actual or potential hazardous atmosphere, and that the hazardous atmosphere can be controlled by continuous forced air ventilation alone, then entry may be allowed using these alternate procedures

1. *Eliminate conditions making it unsafe to remove an entrance cover.*
2. Guard opening to the space with a barrier to prevent accidental fall.
3. Post warning signs.
4. Test the atmosphere with calibrated, direct-reading instruments for:
  - a) Oxygen (must be between 19.5 and 23.5 %)
  - b) Flammability (must be less than 10% of the LEL)
  - c) Potential toxic air contaminants.

The lead worker who has completed training in the use of the gas detection equipment used to conduct the testing must perform testing.

Note: Entry must not be authorized if a hazardous atmosphere exists.

5. Continuous forced air ventilation shall be used as follows:
  - a) No entry will be made until forced air ventilation has eliminated any hazardous atmosphere.
  - b) Ensure ventilation equipment is set up in an area that is clean and free from airborne contaminants.
  - c) Ensure that the ventilation is directed toward the area where the entrant is working. Ventilation shall be provided for as long as the entrant is in the space. If ventilation is interrupted, entrants will immediately leave the space. Reentry will be made only after ventilation is restored and the atmosphere has been retested and determined safe for reentry.
6. Test the atmosphere periodically for O<sub>2</sub>, LEL, and toxics. Follow any specific periodic monitoring instruction listed in space specific guidelines.
7. If a hazardous atmosphere is detected during entry:
  - a) Entrants must leave the space immediately.
  - b) The space shall be evaluated to determine how the hazardous atmosphere developed.
  - c) The hazards will be controlled prior to reentry into the space.
8. No fewer than two authorized entrants will be on-site during confined space entry activities.

**Prepare a Space Specific Written Permit Program:  
Alternate Entry Requirements**

9. Supervisors will certify, in writing, that the above pre-entry measures have been taken. Certification will include the date, the location of the space and the signature of the supervisor serving as a responsible entry supervisor. The confined space entry permit may be used to document this certification.



## **Prepare a Space Specific Written Permit Program: Rescue Requirements**

Provide for timely rescue and other emergency services congruent to the specific hazards associated with the specific space

1. Recognize **foreseeable hazards** or reasons for evacuation.

2. Develop a **rescue plan** for each foreseeable event.

This plan should be part of your written confined space entry program. Some issues to consider are

- The specific hazard or reason for evacuation
- Physical features of the permit space, including points of entry and exit, accessibility to rescue teams, etc.
- Entry procedures
- In-house Rescue Resources vs. Outside Rescue Resources. These will include
  - i) Number of personnel required for rescue
  - ii) Method of contact or communication with rescue team
  - iii) Response time
  - iv) Rescue and emergency treatment equipment availability
  - v) Training status and level of expertise
  - vi) Level of involvement authorized
  - vii) Need for simulated, hands-on, rescue practice for type of permit space.

**Note:** Do not assume that outside emergency help will be available and adequate. Research the above resources beforehand and consider making an “outside service agreement” with emergency service providers for those situations requiring them.

3. Provide **in-house emergency rescue personnel** the training, equipment, and access to permit spaces for practice rescues so that they have the capabilities required by OSHA to safely conduct confined space rescues.

### **Levels of Response**

Different levels of response are available in any emergency situation:

- **Self-rescue.** Self-rescue, of course, is most desirable, in which entrants evacuate the space unaided. If this is not possible, then we move to the next higher level.
- **Retrieval (non-entry rescue)** allows rescuers to evacuate an entrant without entering the work space. If retrieval devices fail or are not practical, rescuers resort to the highest level of response.
- **Entry Rescue** requires the entry of trained rescue personnel into the space.
- **Rescue Stand-by** is the continuing presence of rescuers throughout the entry. OSHA requires this level of response availability when entry involves an IDLH (immediately dangerous to life or health) atmosphere.

## **Prepare a Space Specific Written Permit Program: Rescue Requirements**

**Attendants** will only attempt **retrieval or non-entry rescue**. To facilitate non-entry rescue, retrieval systems or methods shall be used whenever an authorized entrant enters a permit space, unless the retrieval equipment would increase the overall risk to the entrant or would not contribute to the rescue of the entrant. Non-entry retrieval systems shall meet the following requirements:

- a. Each authorized entrant shall use a **chest or full body harness**, with retrieval line attached at the center of the entrant's back near the level of the shoulder or above the entrant's head. **Wristlets** may be used in lieu of the chest or full body harness if it can be demonstrated that the use of a chest or full body harness is not feasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.
- b. The bitter end of the **retrieval line** shall be attached to a mechanical device or fixed point outside the space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve entrants from spaces *more than five feet deep*.

If, in the course of an entry, an attendant becomes aware that the entrant needs assistance in escaping from the space, the attendant will:

- a. Summon rescue and other emergency services, and
- b. Begin non-entry rescue procedures.

If an injured entrant is exposed to a hazardous material, a copy of the *MSDS* for that material will be made available to the medical treatment facility. Specific rescue requirements will be included in written space-specific entry programs and should include, where appropriate, decontamination requirements in the event of hazardous material exposure.

Attendants may enter a permit space to attempt a rescue if they have been trained and equipped for rescue operations and if they have been relieved of their attendant duties by another qualified attendant.

## **Implement a Permit System**

Before any entry into a permit-required confined space is authorized, an **Entry Permit** must be prepared. This permit verifies and documents that effective controls are in place, that safe entry conditions exist prior to permit space entry, and that all other pre-entry requirements have been completed.

1. The permit will be available to all authorized *entrants* and posted at the entrance to the space.
2. Permits will be valid for not longer than the time required to complete the task identified on the permit. Permits will be cancelled when the covered entry operations have been completed or when a condition that is not allowed under the permit occurs in or near the space.
3. Permits must include the following information:
  - a. Space identification
  - b. Purpose for entry
  - c. Date and duration of the permit
  - d. Names of authorized entrants
  - e. Names of attendants
  - f. Name of the Entry Supervisor
  - g. The hazards that may be encountered
  - h. Hazard control measures used (examples include lockout and tag-out, ventilation)
  - i. Acceptable entry conditions
  - j. Results of initial and periodic testing
  - k. Rescue and emergency services
  - l. Communication procedures
  - m. Required equipment

*A "**hot work permit**" is required when any operations capable of providing a source of ignition (for example, riveting, welding, cutting, burning, and heating) are to be performed. The employer signs written authorization for this type of operation within a permit space.*

The **park structural fire coordinator** must get involved whenever hot work is to be done, as he is the person in the park who has been properly trained and designated to issue Hot Work permits under the requirements of NPS RM58.

## **Train Personnel**

*The following **training requirements** are the minimum and must be completed before authorized personnel are allowed to work around or in a confined space. Personnel shall be trained as follows:*

- a. Before they are first assigned duties;
- b. When there is a change in assigned duties; and
- c. When changes in operations present new hazards; and
- d. When inadequacies in knowledge and competencies are perceived.

Training must be documented.

**Entry Supervisor:** The entry supervisor will be trained in

1. the duties and responsibilities of the entry supervisor,
  - a. Know the hazards that may be faced during entry and know the signs, symptoms, mode and consequences of exposure.
  - b. Verify, by checking, that the entry permit has been completed properly, that all required tests have been performed and recorded on the permit, that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin.
  - c. Terminate the entry and cancel the permit when prohibited conditions arise and the safe condition in the space has changed.
  - d. Verify that rescue services are available and that the means for summoning them is operable.
  - e. Designate individuals authorized to enter the permit space. Prevent unauthorized individuals from entering the space.
  - f. Monitor the conditions in and around the confined space and ensure operations remain consistent with the terms of the entry permit and that acceptable entry conditions are maintained.
  - g. Determine the number of attendants needed and the requirements for rescue persons, teams and resources.
2. the duties and responsibilities of authorized entrants, attendants, and rescue personnel (outlined below),
3. the requirements of this program,
4. first aid and CPR,
5. the specific hazards and entry requirements of each confined space.

## **Train Personnel**

**Authorized Entrants:** Authorized entrants will be trained in the duties and responsibilities of the Entrant,

- a. Know the hazards that may be faced during confined space entry and work.
- b. Know how to properly use all supplied equipment for work, entry, and exit.
- c. Communicate with the attendant as necessary to enable the attendant to monitor entrant's status.
- d. Alert the attendant when warning signs and symptoms of exposure are recognized and when prohibited conditions are detected.
- e. Know how to exit the permit space quickly.
- f. Recognize the designated evacuation alarm.

**Attendants:** Attendants will be trained in the duties and responsibilities of an attendant

- a. Know the hazards that may be faced during entry, including information of the mode, signs and symptoms, and consequences of exposure to the hazards.
- b. Be aware of possible behavioral effects of hazard exposure in authorized entrants.
- c. Continuously maintain an accurate count of authorized entrants in the permit space.
- d. During entry operations remain outside the permit space until all entrants have exited the permit space or until relieved.
- e. Maintain communication with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the permit space.
- f. Monitor activities inside and outside the permit space to determine if it is safe for entrants to remain in the space. Order evacuation if the following conditions occur:
  - Attendant detects prohibited conditions.
  - Attendant detects behavioral effects of hazard exposure in entrants.
  - Attendant detects a situation outside the space that could endanger the entrants.
  - Attendant cannot effectively and safely perform all of his or her duties.
- g. Summons rescuer and other emergency services as soon as it is determined that authorized entrants may need assistance to escape from permit space hazards.
- h. Warn unauthorized personnel that they are not allowed to enter the permit space.
- i. Perform non-entry rescue.
- j. Perform no other duties that may interfere with the attendant's primary duty to monitor and protect the entrants.

**Rescuers:** Rescuers will be trained in the duties and responsibilities of a Rescue person,

- a. Ensure rescue and personal protective equipment is available and functional.
  - b. Ensure that training requirements have been met for all team members
  - c. Know the hazards associated with the space that might be encountered during a rescue prior to entry.
2. in the duties of the Entrant (outlined above),
  3. the proper use of personal protective equipment and rescue equipment,
  4. first aid and CPR.
  5. Initially, and once every 12 months, rescuers must practice making permit space simulated

**Train Personnel**

rescues which involve removal of dummies or actual persons from representative spaces. Initial training must be provided prior to allowing personnel to perform rescues.

## **Record Keeping**

The following types of records are required to be maintained by law:

1. **Confined space evaluations and exposure assessments**  
should be maintained and updated for *as long as the space exists*.
2. **Entry permits and written certifications** for a *minimum of one year*. Because exposure data is often included in these records—for example, air sampling data of atmosphere entered by employees—retention may be advised or required for longer periods (see 29 CFR 1910.1020).
3. **Equipment** records regarding
  - Respiratory equipment use and maintenance as per NPS Respiratory Protection Program requirements
  - Retrieval equipment certification and maintenance
  - Atmospheric monitoring equipment maintenance
  - Ventilation equipment
  - Personal protective equipment
  - Fall protection equipment and emergency/rescue equipment.*Retain for one year.*
4. **Training**, including
  - Supervisor, entrant, attendant, and rescuer training
  - In-house rescue personnel practice
  - First-aid and CPR certification
  - Specialized training, such as ventilation training.*Retain for duration of employment plus one year.*
5. **Medical Records**, including
  - Physical exams of entrants and rescuers
  - Contaminant exposure records
  - Respiratory fit-testing/medical surveillance, etc.*Retain for duration of employment plus one year.*
6. **Space-specific Written Permit Space Programs**  
Reviewed and updated annually

## **Appendix A: Helpful Resources**

### **NPS Risk Management**

<http://www.nps.gov/riskmgmt/>

David Bleicher  
Industrial Hygienist, NPS Risk Management  
[david\\_p\\_bleicher@partner.nps.gov](mailto:david_p_bleicher@partner.nps.gov)  
202 513 7224

### **Regional Risk Managers**

Northeast Region  
Daniel Sullivan  
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215 597 5386

National Capital Region  
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202 619 7266

Southeast Region  
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404 562 3108 ext 650

Midwest Region  
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[Vern\\_Hurt@nps.gov](mailto:Vern_Hurt@nps.gov)  
402 221 3419

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303 969 2111

Pacific West Region  
Larry Nolan  
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206 220 4246

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**Appendix B Confined Space Evaluation Worksheet (page 2)**

Surveillance and Inspection Requirements: (Include testing required and frequency)

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Ventilation Requirements:

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Special Entry Requirements:

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Personal Protective Equipment Requirements:

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Rescue Equipment and Procedures:

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## Appendix C Written Permit Space Program Examples

### Example 1: Written Permit Space Program for Sewer Manholes

Space:

COSP 001 Sewer Manhole, Maintenance Annex Facility  
COSP 002 Sewer Manhole, Visitor's Center

Classification: Permit Required Confined Space (Alternate entry methods may be used if criteria are met for Sewer Manhole)

Reason for Entry: Cleaning and Maintenance

Hazards:

- a. Oxygen deficiency. (O<sub>2</sub> deficient atmospheres were found in space COSP 001 (18%) during evaluation)
- b. Flammable atmosphere. (methane). (Flammable atmosphere was detected in space COSP 002 (10% LEL)
- c. Toxic Gas. (Hydrogen sulfide)
- d. Biological Hazards. (communicable disease agents)
- e. Restricted movement
- f. Drowning (standing water)
- g. Falls (space COSP 002, approximately 20 feet)
- h. Landfill leachates (space COSP is down gradient from landfill)
- i. Ladders in disrepair or poor design (spaces COSP 001 and COSP 002)

Surveillance and Inspection Requirements

- a. Test atmosphere directly beneath cover for percent O<sub>2</sub> and combustible gas (%LEL) prior to opening covers.
- b. Test atmosphere with calibrated direct reading meter or instrument for:
  - 1) Percent oxygen content
  - 2) Percent of the lower explosive limit
  - 3) Hydrogen sulfide concentration (ppm, H<sub>2</sub>S)
- c. Inspect for sludge or other foreign material at the bottom or sides of the space that might give off flammable or toxic substances when disturbed by work activity. Floor of space must be visible.
- d. Monitor atmosphere continuously in the vicinity of workers in the space.
- e. All pumps and lines that may reasonably cause contaminants to flow into the space shall be disconnected, blinded and locked out, or effectively isolated by other means to prevent development of

dangerous air contamination or engulfment. Laterals to sewers or storm drains may not require blocking if experience or knowledge of use indicates there is not a reasonable potential for contamination of air or engulfment in the occupied sewer.

### Entry

- a. If no atmospheric hazards are present and visual inspections reveal no potential hazard, the space may be entered using alternate procedures as described
- b. If public has access, the area will be demarcated and a barrier erected to keep pedestrians from falling and to keep objects from falling into the space and injuring the entrant.
- c. All electrical power sources will be isolated.
- d. Do not use Freon for leak detection.
- e. Use only explosion-proof electrical equipment and lighting. All electrical switching connections and disconnections must be made outside the space and away from the opening.
- f. If atmospheric hazards are present, the space must be ventilated. Where possible, open additional manholes to increase air circulation. Use mechanical ventilation to augment natural circulation if needed. After ventilation, repeat testing and follow Permit required entry procedures.

### Personal Protection and Protective Equipment

- a. Protective clothing to prevent contact with raw sewage residues.
- b. Coveralls
- c. Rubber or PVC boot and gloves. Ensure that boot soles and glove contact surfaces provide good traction and grip so that slips and falls are prevented.
- d. Hard hat
- e. Ensure that individuals follow good hygiene practices and wash after entry is complete.

### Rescue

- a. Provide and secure ladder for entry and egress. Ladders fixed in place must be clear and in good repair.
- b. Safety harness and life line required
- c. Tripod and winch to assist a non-entry rescue required.

## Appendix C Written Permit Space Program Examples

### Example 2: Written Permit Space Program for Sewage Lift Station Dry Wells

*Space:*

COSP 003 Sewage lift station dry well, North Cape site  
COSP 004 Sewage lift station dry well, South Beach

*Classification:* Permit-required confined space, Alternate entry methods may be used when criteria have been met.

*Reasons for entry:*

- a. Space COSP 003 is abandoned and secured. No entry is permitted.
- b. Space COSP 004—Cleaning, maintenance, meter reading and logging.

*Hazards:*

- a. Oxygen deficiency
- b. Flammable atmosphere. (methane)
- c. Toxic Gas. (CO)
- d. Falls

*Surveillance and Inspection:*

- a. Test atmosphere with calibrated direct reading meter or instrument for
  - 1) Percent oxygen
  - 2) Percent of lower explosive limit
  - 3) Carbon monoxide
- b. Ensure that mechanical ventilation systems in dry well has been turned on and operating for at least 5 minutes prior to entry.

*Entry:*

- a. If no atmospheric hazards are present and visual inspection reveals no potential hazard, the space may be entered using alternate entry procedures.
- b. Use integral restraint systems installed in dry well. Attach lifeline prior to stepping onto platform.
- c. In locations where general public is not restricted, area will be demarcated and barrier erected to keep pedestrians from falling and to keep objects from falling into the space and injuring the entrant.

- d. Do not use Freon for leak detection.

*Personal Protection and Protective Equipment.* Ensure that soles and glove contact surfaces provide good traction and grip so that slips and falls are prevented.

## Appendix C Written Permit Space Program Examples

### Example 3: Written Permit Space Program for Steam Vaults

*Spaces:*

COSP 005, Steam Vault, North Administration Building  
COSP 006, Steam Vault, East Administration Building

*Classification:* Permit-required confined space

*Reasons for entry:*

- a. Annual inspection
- b. Maintenance. Steam distribution system maintenance may include welding and cutting with acetylene torch, valve packing, pipe repair.

*Hazards:*

- a. Oxygen deficient atmosphere
- b. Combustible gases or vapors (organic hydrocarbons, fuel vapors from adjacent fueling station in space COSP 005).
- c. Toxic gases or vapors.
- d. Introduced hazard during welding and cutting (O<sub>2</sub> enrichment, acetylene, smoke, welding fumes).
- e. Hot surfaces
- f. Live steam
- g. Combustible solids (litter in space COSP 005)
- h. Asbestos pipe insulation (presumed asbestos material in space COSP05)
- i. Ladders in disrepair.

*Surveillance and Inspection:*

- a. Test atmosphere with calibrated direct reading meter for:
  - 1) Oxygen
  - 2) Flammable atmosphere
  - 3) Toxic gases and vapors appropriate to the task

Note: Meters may be sensitive to high humidity within steam vaults resulting in high reading for some instruments.
- b. Drop tests must performed. Test all locations and depths within the vault.
- c. Inspect for sludge or other foreign material on the bottoms and sides of the space. These may give off flammable or toxic substances if disturbed by walking or heated by hot work.
- d. Isolate steam prior to entry.

- e. Continuously monitor atmosphere for oxygen content, LEL and toxic during hot work.

*Ventilation:*

- a. Provide continuous forced air ventilation to entrants during entry.
- b. Provide local exhaust ventilation during hot work to remove smoke, gases and fumes produced.

*Entry:*

- a. Area will be demarcated and a barrier erected to keep pedestrians from falling and to keep objects from falling into the space and injuring the entrant.
- b. Remove combustible materials such as litter and clean surfaces of oils or other combustible substances prior to hot work.
- c. Compressed gas cylinders must not be taken into spaces. Inspect hoses, connections and torches of gas welding and cutting equipment prior to use.

*Personal Protective equipment:*

- a. Hard hat
- b. Coveralls
- c. Steel toed rubber boots
- d. Safety goggles or glasses
- e. Heat protective gloves when appropriate

*Rescue:*

- a. Provide ladder or other means to ensure easy and safe entry and egress.
- b. Provide and use safety harness and lifeline
- c. Provide tripod and winch to assist in non-entry rescue.



## Appendix C Written Permit Space Program Examples

### Example 4: Written Permit Space Programs for Fuel tanks

#### *Spaces*

COSP 007, Used Oil Tank, 3500 gal, North Hill  
COSP 008, Fuel Oil Tank, Maintenance Facility  
COSP 009, Gasoline Tank, Maintenance Yard

*Classification:* Permit-required confined space.

*Reasons for Entry:* Cleaning and sludge removal.

#### *Hazards:*

- a. Oxygen deficient atmosphere (oxidation processes)
- b. Flammable vapors
- c. Toxic vapors (organic hydrocarbons)
- d. Benzene (COSP 009)
- e. Dermal exposure to hydrocarbons

#### *Surveillance and Inspections:*

- a. Test atmosphere with calibrated, direct reading, intrinsically safe meter for:
  - 1) Oxygen content
  - 2) Percent of LEL
  - 3) Toxic vapors (petroleum hydrocarbons in spaces COSP 007 and 008) (benzene in COSP 009)
- b. Test at all locations and depths within the tank. Pay particular attention to areas where vapors may pocket such as sumps and baffled areas. Test through openings with a drop tube.
- c. Continuously monitor atmosphere for oxygen content and percent LEL, and for toxic vapors every 15 minutes.
- d. Monitor for % LEL (and benzene for space COSP 009) in the area surrounding the tank during purging.

#### *Ventilation:*

- a. Remove all ignition sources prior to purging.
- b. Purge tank and maintain forced ventilation during entry.
- c. Ensure ventilation equipment is properly bonded or grounded.
- d. Vent vapors well away from tank. Ensure vapors do not collect in low spots.

- e. Do not use steam to purge tank.

### *Entry*

- a. Post the following signs in the vicinity of the tank:
  - 1) NO SMOKING
  - 2) HARD HAT AREA
  - 3) NO OPEN FLAMES OR SPARK PRODUCING EQUIPMENT BEYOND THIS POINT
- b. Ensure all portable hand tools are explosion proof and designed for hazardous atmospheres.
- c. Ensure all portable electric equipment capable of generating static electricity is properly bonded or grounded if tank is non-metallic.
- d. Have at least 2 fire extinguishers, B/C rated, within easy access.
- e. When possible pass through portals near ground level (within 3 feet) rather than portals at the top of the tank.

### *Personal Protective Equipment:*

- a. Hard hat
- b. Chemical protective coveralls
- c. Chemical protective boots
- d. Safety goggles
- e. Chemical protective gloves

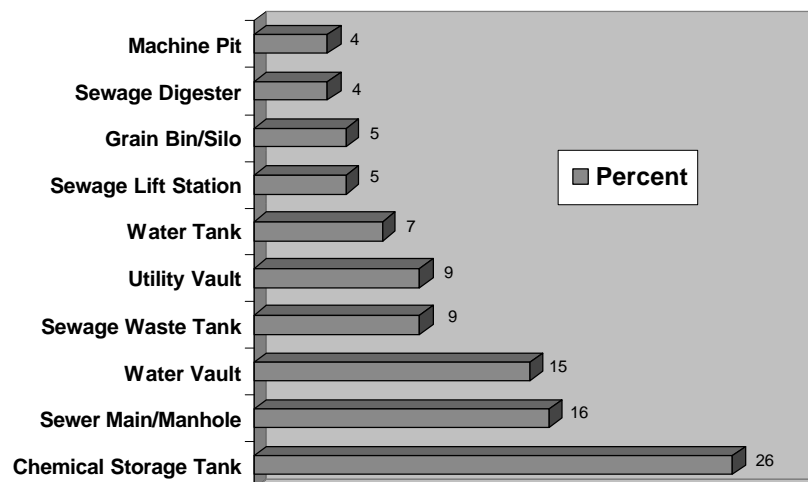
### *Rescue:*

- a. Provide ladder or other means to ensure easy and safe entry and egress.
- b. Provide and use safety harness and lifeline.
- c. Provide tripod and winch to assist a non-entry rescue.

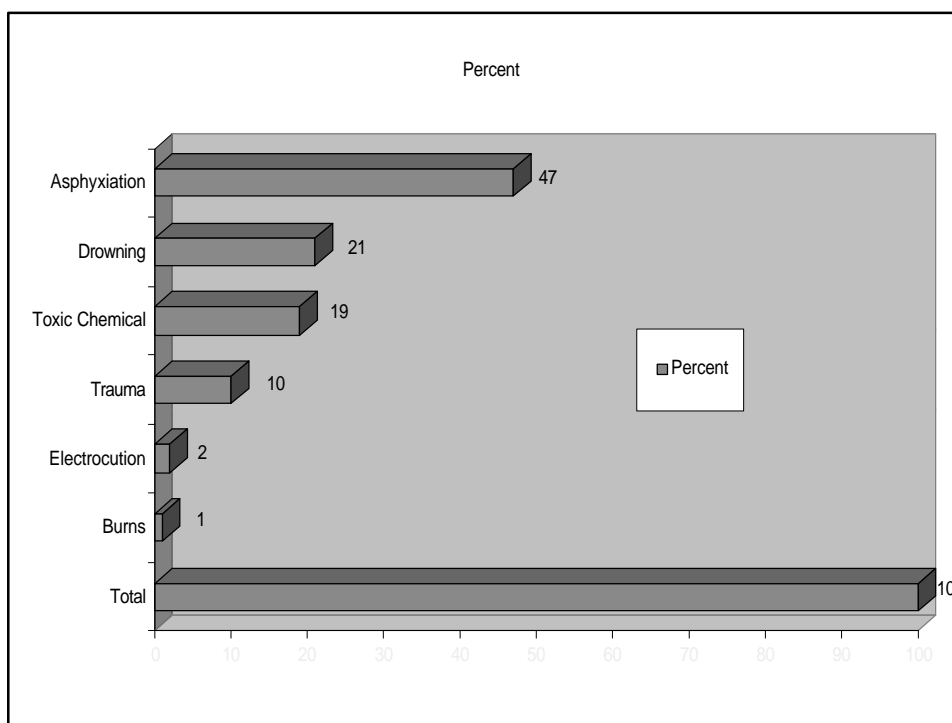
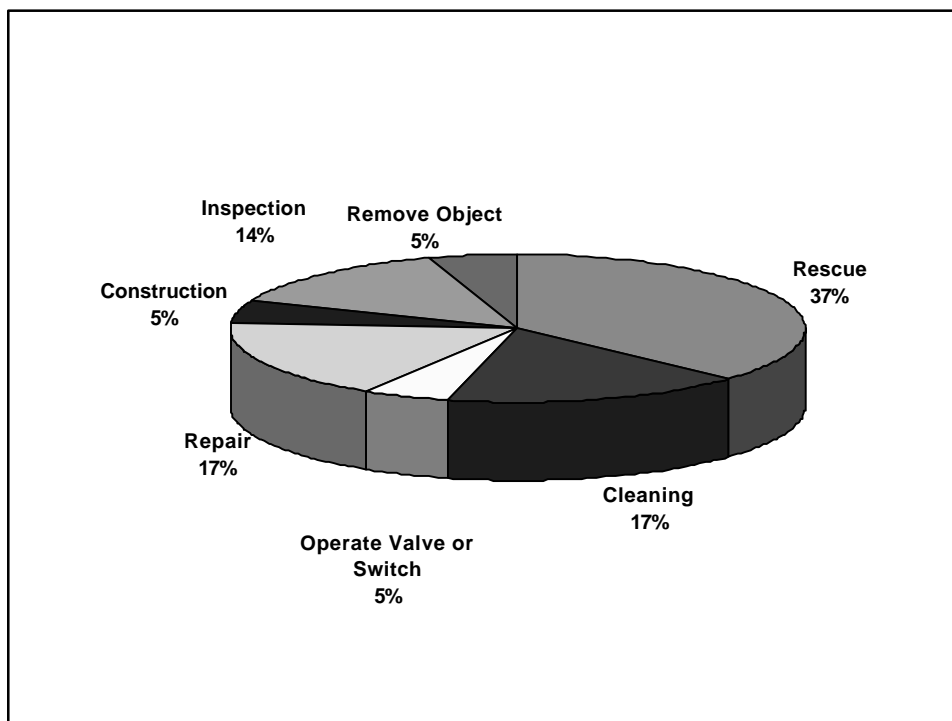
## Appendix D: NIOSH Study of Accidents in Confined Spaces

### NIOSH Study

- 20,000 accidents
- 276 of these involved confined spaces
- These 276 accidents resulted in 234 deaths and 193 injuries
- 60% of the 234 deaths were rescuers
- 50% of the accidents involved 1 or more supervisors

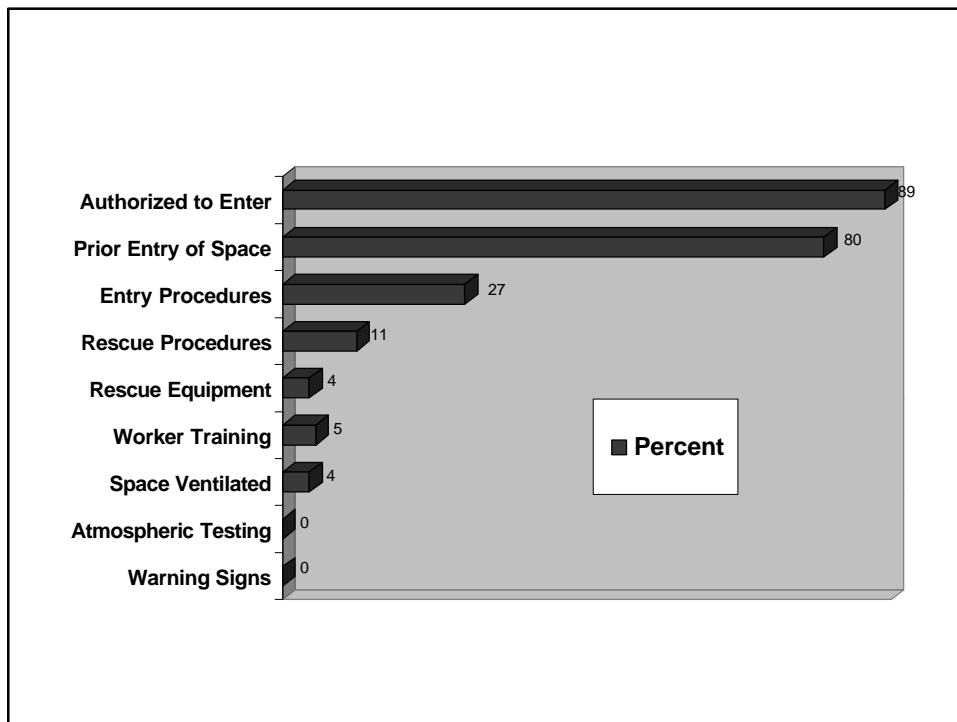


## Appendix D: NIOSH Study of Accidents in Confined Spaces



## Appendix D: NIOSH Study of Accidents in Confined Spaces

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### Reasons Confined Space Accidents Occur

- Fail to recognize confined spaces & associated dangers
- Too trusting of their senses
- Underestimate the danger
- Become complacent
- Attempt to rescue their colleagues